

# SURVEY OF THE FRESHWATER TURTLES OF INDIA PART I: THE GENUS *KACHUGA*<sup>1</sup>

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(With a colour plate and eight text-figures)

*Kachuga* is the most diverse genus of the Asiatic batagurines. This paper recognizes 7 species and 10 subspecies (one new and one resurrected). All but one occur in India. Egg shell and penial morphology support a close relationship of *Kachuga* to *Batagur*, *Callagur*, *Hardella*, and *Morenia*. Two distinct species' groupings evident within the genus are tentatively designated the subgenera *Kachuga* and *Pangshura*. The former contains the larger (>40 cm CL) species, *K. dhongoka* and *K. kachuga*; the latter includes the smaller (< 30 cm CL), *K. smithii*, *K. sylhetensis*, *K. tecta* and *K. tentoria*. Sexual dimorphism in size characterizes both groups but pronounced sexual dichromatism is known only in the *Kachuga*. Members of both subgenera are highly aquatic, herbivorous species but differ in other aspects of their ecology. Members of the subgenus *Kachuga* are inhabitants of moderate to large rivers, nesting on sand banks chiefly in March and April. Members of the *Pangshura* inhabit lentic as well as lotic habitats and nest in the winter months of October through January in a variety of situations.

Keys and descriptions are provided for identifying each species and subspecies. Verified locality records are plotted on distribution maps.

## INTRODUCTION

India boasts one of Asia's most diverse assemblages of chelonians. At least 5 families, 23 genera and 31 species occur within the boundaries of the country. Generally the distribution and the biology of these species are poorly known. Much of our knowledge of this assemblage comes from writings of the British naturalists of the nineteenth and early twentieth century. For the most part these men were concerned only with taxonomy. Their locality data were seldom precise (e.g. North India, Peninsular India) and natural history data were rarely provided. To further complicate

matters much of the describing and classifying was done by museum curators such as John Edward Gray, Albert Guenther, and George Albert Boulenger who had never been to India and who often relied on second hand information, drawings and dried specimens to prepare their accounts. Considerable confusion and lengthy synonymies have resulted. Malcolm Smith's 1931 treatise on chelonians in *The Fauna of British India* series did much to summarize the available information and to reduce confusion. Nevertheless the distributions given were still sketchy and little natural history information was provided.

A long lapse followed Smith's work during which time there was meagre interest in field biology of turtles particularly freshwater species. With a few exceptions (e.g. Acharji

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1950, 1955, Hora 1948, Jayaram 1974) only a scattering of small notes concerning freshwater chelonians appeared in the Indian journals from the thirties to the eighties. Interest was rekindled by conservation concerns of the IUCN (International Union for Conservation of Nature and Natural Resources). Meeting in conjunction with the 1981 Convention on International Trade in Endangered Species (CITES) in New Delhi, the newly formed Freshwater Chelonian Specialist Group (FCSG) of the IUCN noted that a proportionately large number of the chelonians listed on CITES Appendices I & II (endangered and threatened categories) inhabited India and Bangladesh. It also noted that there were few data concerning the status and distribution of these species in the region. A survey of the freshwater chelonians of India to obtain data on their distribution and conservation status was given a "highest priority" status for action by the group.

The initial survey of the Indian chelonians was funded by a grant from World Wildlife Fund to Rom Whitaker and me and was carried out by Ms. J. Vijaya in West Bengal and adjoining states from August 1981 to February 1982. This was followed by a more extensive survey of Indian rivers and markets from September 1982 to June 1983 conducted by myself, Vijaya and Satish Bhaskar with funding from an Indo-American Fellowship. Some of the findings of these surveys have now been published or are accepted for publication (Groombridge *et al.* 1983; Moll 1983, 1984, 1985, in press a, b, c.). Publicity about these surveys and the plight of the South Asian chelonians in general helped to spark the interest of other investigators, contributing to a flurry of recent publications (many conservation oriented) concerning these species (e.g. Das 1986, Khan 1982, Rao and Singh 1984,

1985; Vijaya 1982a, b, c, d, e, f, g, h, i, j, 1983a, b, c, d, e; Whitaker 1982, and Yadava and Prasad 1982a, b).

This paper begins a several part series aimed at incorporating the findings of the aforementioned surveys with recent information from other authors to provide an updated account concerning identification, distribution and biology of the Indian freshwater chelonian fauna. This part considers the Indian representatives of the most diverse genus of Asiatic batagurines, the *Kachuga*.

## METHODS

In the course of our surveys, we visited 14 major rivers: the Ganges and its tributaries (the Hindon, Yamuna, Chambal, Ghagra, Rapti, Gandak and Hooghly) along with the Subharnareka, Mahanadi, Godavari, Cauvery, Narmada and Tapi. Typical procedure of these surveys included sampling available habitats with baited hoop traps (Legler 1960) and trammel nets, contacting fishermen and market vendors for information and specimens, and canvassing garbage dumps for skeletal material. Voucher specimens for most localities have been placed in the collections of the Bombay Natural History Society (BNHS) or the Field Museum of Natural History in Chicago (FMNH). A few have been kept alive for captive breeding purposes at the Madras Crocodile Bank. Others are in the author's possession (EOM).

Specimens were measured with aluminium forestry calipers, weighed with portable spring scales and described before being preserved or released. Standard measurements, given in centimeters unless otherwise indicated, are maximum carapace length (CL), carapace width (CW), plastron length (PL) and height of shell (H). Color descriptions of living

specimens were made using color swatches of Smithe (1975). Scute and bone terminology of the shell follows Zangerl (1969). Common names follow Iverson (1985) except that terrapin has been substituted for turtle in the *Kachuga* to be consistent with the names of close relatives (painted terrapins — *Callagur*; river terrapins — *Batagur*).

Keys, descriptions and colored photographs showing ontogenetic and sexual variation are provided herein to facilitate identification. To save space in the descriptions certain forms of abbreviation have been used requiring explanation: The seam contact formula indicates where the seams of the pleural scutes contact the marginals. The abbreviations used are modified from that of Tinkle (1962). Five pleural or carapacial seams contact the marginal scutes. The anterior edge of the first pleural typically contacts the first marginal. To indicate whether this contact is usually in the anterior, middle or posterior third of the marginal scute, the respective designations of 1<, 1M, or 1> are used. The formula 1M 4> 6> 8M 11< indicates that the five contacts were middle third of Marginal 1, posterior third of Marginals 4 and 6, middle third of Marginal 8 and anterior third of Marginal 11.

The neural formula signifies the number of sides on each of the eight neurals (i.e. 4, 6, or 8). For hexagonal neurals the symbols > and < denote whether the short sides of the bone are located anteriorly or posteriorly (see Fig. 3). When the number of sides is highly variable a range is given (e.g. 4-6).

The plastral formula indicates relative lengths of the plastral scutes along the midline of adults (juveniles often differ). Scute abbreviations are: G = gular, H = humeral, P = pectoral, Ab = abdominal, F = femoral, and A = anal. The signs >, <, and >< connote res-

pectively — greater than, less than, and either may be the larger.

Other abbreviations include: RCM — Relative clutch mass (modified from Vitt and Price 1982) is the ratio of clutch mass to body mass of the spent female. ELI — Egg length index is the ratio of mean egg length to carapace length  $\times 100$ . EWI — Egg width index is the ratio of mean egg width to carapace length  $\times 100$ . EMI — Egg mass index is ratio of mean egg weight to body mass  $\times 100$ . AP, MP, and UP are used to indicate the states of Andhra Pradesh, Madhya Pradesh and Uttar Pradesh in localities.

In addition to specimens collected on the surveys, I was able to examine the collections of chelonians in the Bombay Natural History Society (all), the Zoological Survey of India in Calcutta (part) and the British Museum of Natural History (BMNH) in London (part). When positive identification of specimens with seemingly accurate locality data was possible, I have included these in the 'Distribution' section to increase the number of reliable records available for the country.

## RELATIONSHIPS

The *Kachuga* are members of the subfamily Batagurinae of the family Emydidae sensu McDowell (1964). Hirayama (1984) and Gaffney (1984) support elevating the subfamily to familial rank.

The interfamilial relationships of the batagurines are still being debated. See for example McDowell (1964), Carr (1981), Sites *et al.* (1984) and Hirayama (1984). My own studies of the penis and eggs (see below) support the scheme of Hirayama which considers *Kachuga* most closely related to *Batagur*, *Callagur*, *Hardella*, and *Morenia*. This is also similar to the view expressed by Loveridge

and Williams (1957). All of these genera comprise herbivorous and highly aquatic species. Morphological characteristics shared by this group include a large foramen orbitonasale, a broad secondary palate, serrated tomtia, strong plastral buttresses, the entoplastron lying anterior to humero-pectoral sulcus, and fourth marginal scutes contacting the second pleural scutes.

All of the aforementioned genera share a distinctive penial morphology characterized by a highly elaborated plica media (Fig. 1). The lateral fold of the plica media is modified into two pairs of flaps — a proximal rounded pair with a more prominent, pointed pair distally. The smaller, lower medial fold is conspicuously

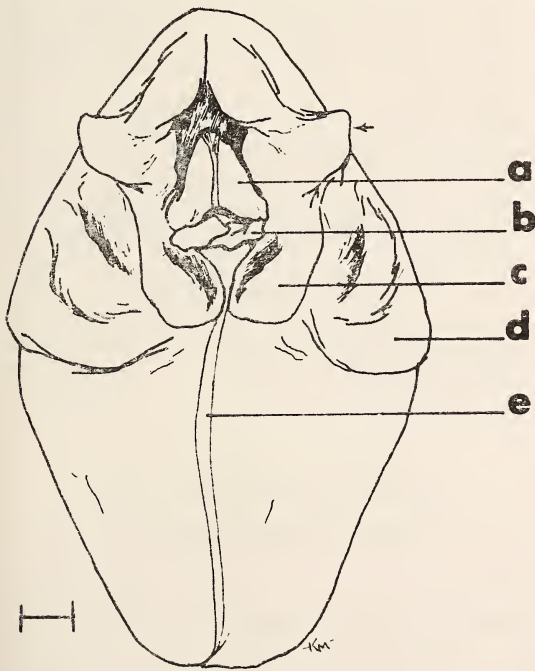


Fig. 1. Penis of *Kachuga kachuga*. Labeled parts as follows: a. Plica media — medial fold. b. Plica interna. c. Plica media — lateral fold (small arrow indicates distinctive pointed flaps). d. Plica externa. e. Seminal groove. Scale marker represents 5 mm.

triangular in shape. No other batagurines have yet been found with this unusual type of penis. The genus *Ocadia* shares the triangular shaped medial fold but the distal flaps of the lateral fold are neither well developed nor pointed.

Ewert (1979) recognized three types of egg shells, brittle, hard-expansible and pliable. *Batagur*, *Callagur*, and *Kachuga* which lay hard-expansible to pliable-shelled eggs are the only batagurines thus far reported that do not lay brittle-shelled eggs. The egg shell type of *Hardella* and *Morenia* is unreported.

Within the genus *Kachuga*, there are two distinct species groups. One comprises the large, riverine species, *dhongoka*, *kachuga*, and *trivittata*. The other includes small to medium-sized turtles, *smithii*, *tecta*, *tentoria*, and *sylhetensis*, that inhabit rivers, nullahs and tanks. Gray (1855) recognizing the distinctness of the two groups placed them as subgeneric divisions (*Kachuga* and *Pangshura*) of the genus *Batagur*. Gunther (1864) and Gray (1869) elevated the *Pangshura* and *Kachuga* respectively to generic rank. Boulenger (1889) subsequently lumped both groups as the genus *Kachuga*. This arrangement which has lasted to present obscures the close relationship of the four smaller species which share a suite of derived characteristics not found in the larger forms. A tentative list of characters defining the two groups is provided in Table 1. The list is tentative as it is based chiefly on material collected by the survey and because no skeletons of *Kachuga sylhetensis* have been examined as yet. A larger study to determine the extent of geographical and individual variation in these characteristics is in progress.

For the purposes of this paper, the evolutionary divergence of these two lines is recognized by resurrecting *Pangshura* and *Kachuga* as subgenera of *Kachuga*.

TABLE 1

DIAGNOSTIC CHARACTERS OF THE SUBGENERA *Kachuga* AND *Pangshura*. NUMBERS IN ( ) INDICATE FIGURE NUMBERS DEPICTING EACH CHARACTER

Character	<i>Kachuga</i>	<i>Pangshura</i>
Upper Jaw (2)	Medial Notch, Weakly Bicuspid	Unnotched.
Neural Formula (3)	4, 6>6>6> 6>6>6>4- 6>	4, 6>6>8, 4, 6>6>4-6>
Apex of Shell (4)	Vertebral 2	Vertebral 3
Fourth Vertebral Scute (5)	Broad Anteriorly, Overlaps 4 neurals	Narrow Anteriorly, Overlaps 5 Neurals
Costo-Peripheral Fontanelles (6)	Remain Prominant in Males	Fused by Maturity or Very Small
Carapace	Three Striped Or Unmarked	Usually Median Stripe Only
Maximum Size	> 40 cm CL	< 30 cm CL

KEY TO THE INDIAN SPECIES OF *Kachuga* (ADULTS)

- 1 Apex of shell at posterior of second vertebral (Fig. 4A); fourth vertebral contacts third broadly (Fig. 5A); upper mandible usually bicuspid with medial notch (Fig. 2A) ..... (subgenus *Kachuga*) 2
- 1' Apex of shell at posterior of third vertebral (Fig. 4B); fourth vertebral attenuated anteriorly, narrowly contacting third (Fig. 5B); upper mandible not bicuspid, lacks medial notch (Fig. 2B) ..... (subgenus *Pangshura*) 3
- 2 Second vertebral pointed posteriorly (Fig. 5A); shell usually patterned with three-stripes, a distinct dark mid-dorsal stripe flanked by less distinct broken or continuous lateral stripes ..... *K. dhongoka*
- 2' Second vertebral not pointed posteriorly; shell lacks a distinct pattern ..... *K. kachuga*
- 3 Fifth vertebral widest at anterior half of scute; usually 13 pairs of marginal scutes with those along posterior border strongly serrated ..... *K. sylhetensis*
- 3' Fifth vertebral widest at posterior half of scute; usually 12 pairs of nonserrated or weakly serrated marginal scutes present ..... 4
- 4 Shell relatively low — maximum height usually less than 44% of maximum length; median keel of carapace with weak or no spine on third vertebral (when present not angled sharply upward) ..... *K. smithii*
- 4' Shell high vaulted — maximum height usually exceeds 45% of maximum length; median keel with prominent spine on third vertebral angled steeply upward (may be worn down in old individuals) ..... 5
- 5 Head patterned with broad orange to red crescentic postocular bands which curve upward from under the eyes often merging to form a chevron at the back of the head; plastral pattern typically of multiple small dark blotches on each scute ..... *K. tecta*
- 5' Head pattern lacks broad crescentic band, one or two reddish to brownish postocular spots often present; plastron with a single, large dark blotch per scute or unmarked ..... *K. tentoria*

SPECIES ACCOUNTS

Genus *Kachuga* Gray 1855  
Indian Roofed Terrapins

Distributed from Pakistan to Burma, the genus contains seven species and ten subspecies, all but one of which occurs in India. Roofed turtles can be distinguished from other batagurines by an elongated fourth vertebral scute which covers all or part of at least four neural bones.





A



B



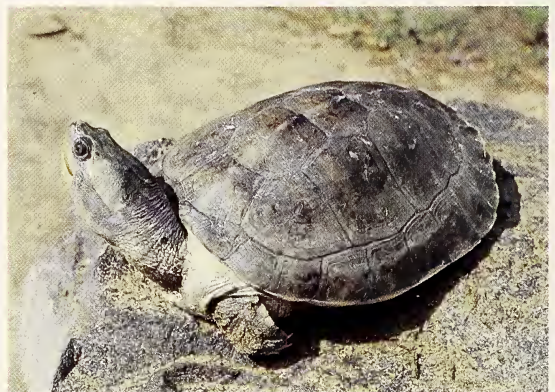
C



D



E



F

(A) *Kachuga dhongoka* — Female (36.9 cm CL) purchased in Calcutta market. (B) *K. dhongoka* — Hatchling (5.3 cm CL) from eggs collected on sand banks of the Chambal River near Bah, U.P. (C) *K. kachuga* — Female (48.4 cm CL) from Yamuna River, at Bateshwar, U.P. (D) *K. kachuga* — Male (29.0 cm CL) from the Chambal River near Barendra, M.P. (E) *K. kachuga* — Hatchling (6.0 cm CL) from eggs collected on sand banks of the Chambal River near Bah, U.P. (F) *K. kachuga* — Immature female (20.5 cm CL) from the Yamuna River at Bateshwar, U.P.

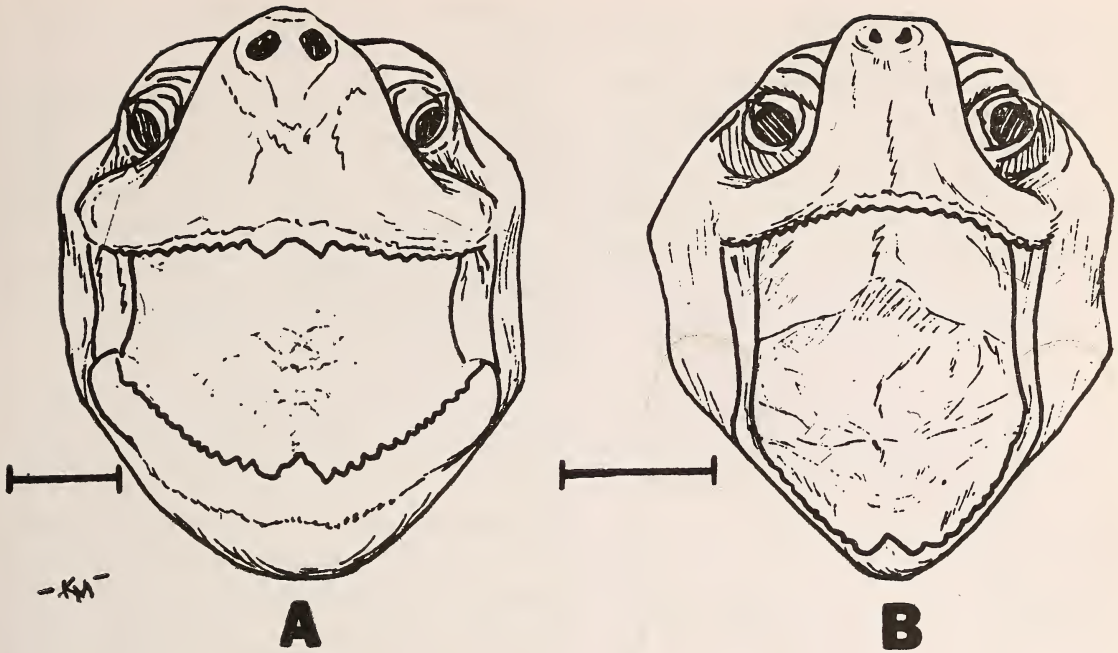


Fig. 2. Anterior view of the heads of *Kachuga kachuga* (A) and *K. tentoria* (B). Note weak bicuspid condition with slight medial notch in A and its absence in B. Scale marker represents 1 cm.

**Description:** Small to large (56 cm CL) aquatic turtles having serrated jaws; an expanded secondary palate bearing one or two denticulated ridges; a large foramen orbitonasale exceeding many times the diameter of the posterior palatine foramen; the fourth marginal scute contacting the second pleural scute; expanded plastral buttresses in which the anterior contacts the first rib and the posterior the fifth and sixth costals near the neural suture; the entoplastron positioned anterior to the humero-pectoral suture; narrow band-like scales on the limbs; and fully webbed feet with five clawed toes on the forefeet and four on the hind feet.

**Subgenus *Kachuga***

Contains three species — *dhongoka*, *kachuga*, and *trivittata* (from Burma). For the most

part this subgenus is diagnosed by plesiomorphic or primitive characteristics shared with sister groups such as *Hardella* and *Callagur* (see Table 1 and Figs. 2-6). They are large riverine species showing moderate sexual dimorphism and with the exception of *dhongoka*, pronounced sexual dichromatism.

***Kachuga dhongoka* (Gray 1834)**

Three -striped Roofed Terrapin — Plate I, A+B

**Identification:** A large riverine *Kachuga* (upto 48 cm CL) identifiable by a single denticulated ridge on the palate, a pattern of three stripes (may be obscure) on the carapace and a posteriorly pointed second vertebral scute in adults.

**Description:** Sexes colored similarly (BNHS 1343 and FMNH 224136); carapace — brownish olive, olive gray or smoke gray



ground color patterned with dark brown to black stripes and marginal border; plastron unpatterned — straw to sulfur yellow or cream but may darken in old adults particularly males; head and neck grayish olive to gray; a cream colored stripe beginning at the snout runs above the eye and tympanum; mandibles and chin light olive yellow to cream but again

may darken in old individuals; iris brown to smoke gray.

Head moderate in size with somewhat up-turned snout projecting beyond jaw; skin smooth anteriorly dividing into small irregular scales at rear of head; apex of upper jaw with shallow notch flanked on each side by small tooth-like projections; triturating surface broad, bearing single denticulated ridge; hyoid (immature female) with cartilaginous body and two pairs of ossified, single element horns.

Shell oval flaring posteriorly being widest across rear of Vertebral 4; a median keel usually evident anteriorly with a pronounced knob on Vertebral 2 and a lesser one on 3; Vertebrae 1, 3 and 4 usually longer than wide while 2, and 5 tend to be as wide or wider than long; seam contact formula: 1M 4 > 6 > 8M 10 >; plastron narrow, truncated anteriorly and notched posteriorly; plastral formula: Ab > F > H >> P > A >< G; bridge broad exceeding length of both anterior and posterior lobes of the plastron; cloacal bursae present.

*Size and Sexual Dimorphism:* The sexes differ greatly in size. Seventeen shells collected along the Ganges River at Rajamahar and Kahalgaoon were divided into male and female types (maturity not known). Average CL of nine "males" was 18.7 (range 15.9 to 21.3) cm while eight "females" averaged 36.6 (range 33.9 to 40.9) cm. The largest male and female examined in West Bengal markets measured 19.8 and 48 cm CL respectively. Chaudhuri (1912) and Das (1986) reported that males do not exceed ten inches and 25.5 cm CL respectively. Seven mature females collected by Rao and Singh (1985) from the Chambal River in Madhya Pradesh averaged 44 cm CL (range 39.2-48.0).

Dimensions of two typical individuals are: Female: 42.2 CL 31.2 CW 38.9 PL 16.3 H.

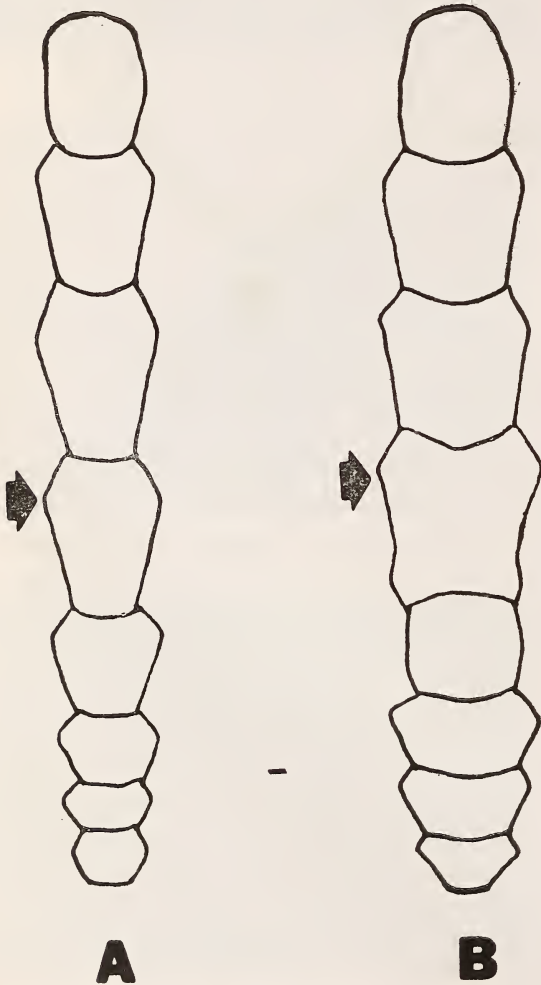


Fig. 3. Neural bones of *Kachuga dhongoka* (A) and *K. tentoria* (B). Arrow indicates the fourth neural which is hexagonal in A but octagonal in B.

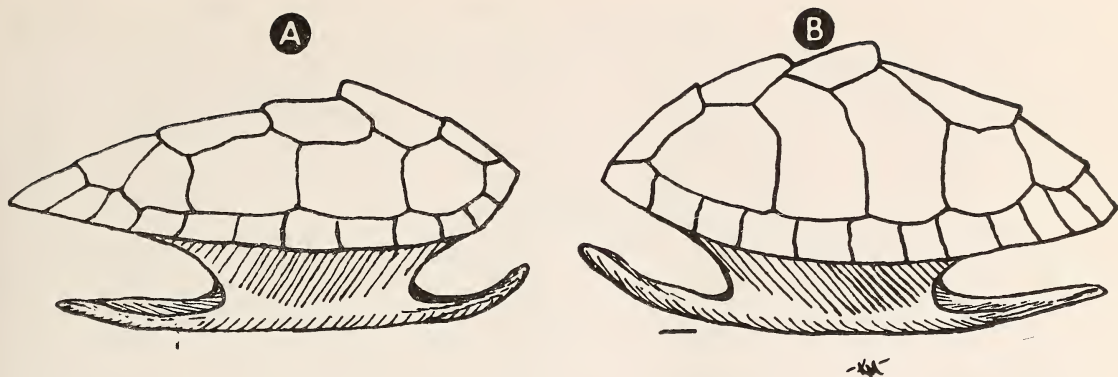


Fig. 4. Shells of *Kachuga dhongoka* (A) and *K. tentoria* (B). Note that the apex of A is at the second vertebral and that of B is at the third vertebral.

Weight 8.25 kg. Male: 19.1 CL 13.3 CW 16.2 PL 7.3 H. Weight 0.85 kg.

In addition to size, males can be distinguished from females by a longer tail in which the cloaca extends beyond the edge of the shell and by the presence of costo-peripheral (usually four prominent and one or two tiny) fontanelles in the carapace (Fig. 6).

**Hatchlings:** Eight hatchlings from four clutches obtained at the Chambal River in Madhya Pradesh had mean dimensions of 5.15 CL 4.41 CW 4.74 PL 2.47 H and mean weight of 24.25 g. Shells of hatchlings are weakly serrated posteriorly (Marginals 7-12). The central keel is broken and modified into two prominent, knobby spines on Vertebrae 2 and 3 and a smaller one on Vertebral 4. Vague lateral keels are represented by a line of tiny tubercles, one each on the areolae of Pleurals 1-4. A pair of keels run along either side of the plastron. Vertebral 2 is not pointed as in adults nor is Vertebral 4 particularly elongate. These characteristics develop with age.

Hatchling coloration is similar to that of adults. The central stripe is usually broken and is most pronounced on Vertebrae 2 and 3.

The lateral stripes are less obvious consisting of a broken line of dashes or spots along the pleural scutes. Another series of dark blotches or dashes usually border the edge of the shell. The underside of the marginals may also be marked with dark pigment but the plastron is unpatterned. Smith's (1931) report of reddish brown patches on the plastral scutes of juveniles was likely an iron-based stain that commonly forms on the shell when turtles burrow in certain substrates. A cream to tan stripe beginning on the snout and running over the eye and tympanum is usually evident.

**Natural History:** The three-striped roofed terrapin inhabits moderate to large rivers. It appears highly aquatic, leaving the water only to bask and for nesting. Like certain other large riverine species (e.g. *Dermatemys*, *Callagur*), adults have considerable difficulty or are unable to right themselves once placed on their backs. The turtle is not aggressive and attempts to bite only after some provocation.

*K. dhongoka* were regularly seen basking on logs, debris, and sand banks during our survey of the National Chambal River Sanctuary, March 31-April 6. However, few were seen basking on an earlier trip during the

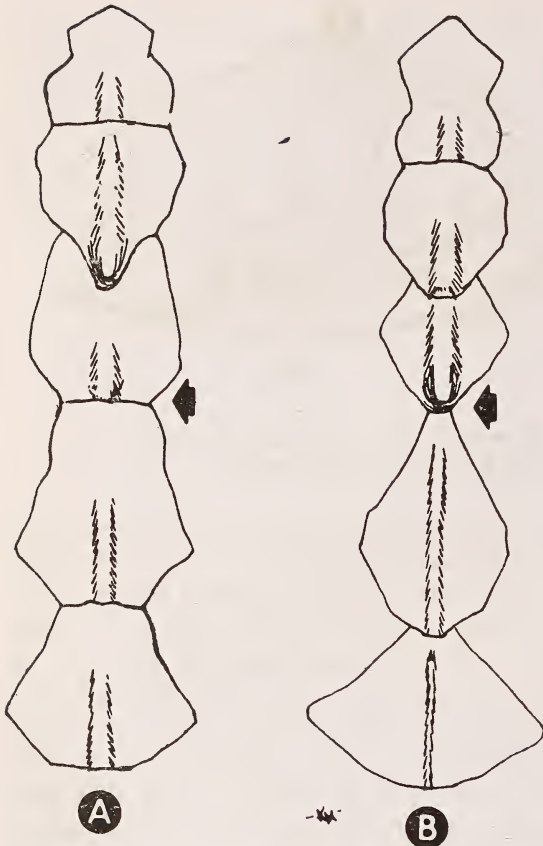


Fig. 5. Vertebral scutes of *Kachuga dhongoka* (A) and *K. tentoria* (B). Arrow denotes broad contact between the third and fourth vertebrals in A but narrow contact in B.

cold season (January 18-29). On this trip two females were captured by fishermen by dragging large hooks over the bottom in deep water (c. 10 m) of the nearby Yamuna River suggesting that some members of the population may have been dormant.

Anderson (1876) reported the species to be herbivorous based on his observations of two captives. Males, however, are omnivorous. Feces of a male (19.8 cm CL) purchased in a West Bengal market were full of bivalve mollusc shells while the digestive tract of

another (19.1 cm CL) contained stems and leaves of aquatic plants and a trace of mollusc shells. No female feces were examined.

Nests of *K. dhongoka* were observed only in March and April at the National Chambal Sanctuary. However, two females reaching the Howrah markets on December 3 were gravid as was one of the aforementioned dormant(?) females collected on 27 January. Rao and Singh (1985) have confirmed that March and April are the peak nesting months in the Sanctuary but they also have found one gravid female as early as 17 December. This suggests the possibility that females may carry shelled eggs for a long period (including a period of dormancy) prior to nesting. The latest evidence of nesting was from the ovaries of a butchered female (38 cm CL) in a market in Belacoba, West Bengal which contained 18 fresh corpora lutea on 28 April.

Nesting takes place on sand banks near the river. Sixty two nests were found from 1 to 100 m (mean 14 m) inland from the river. Five which were excavated had an average depth to the first egg of 21.5 (18 to 27) cm and to the bottom of the nest of 31 (25-35) cm. The nests contained from 21 to 34 (mean 26.2) eggs. Rao and Singh found an average and mode of 23.5 and 25 (16-35) eggs per clutch at this locality in 65 nests examined from 1983 and 1985. Based on 161 eggs from 7 clutches, egg length varies from 46 to 65 (mean 57.3, SD 4.8) mm, egg width from 32 to 39 (mean 35.9, SD 1.5) mm and weight 30 to 55 (mean 43.7, SD 6.1) g. Egg shells vary from flexible to brittle even within a clutch. Usually the shell can be indented with moderate thumb pressure but this often results in localized fracturing of the mineral layer.

Little is known concerning the reproductive effort of individual females. One (42.6 cm CL and 6.65 kg) from the Yamuna River

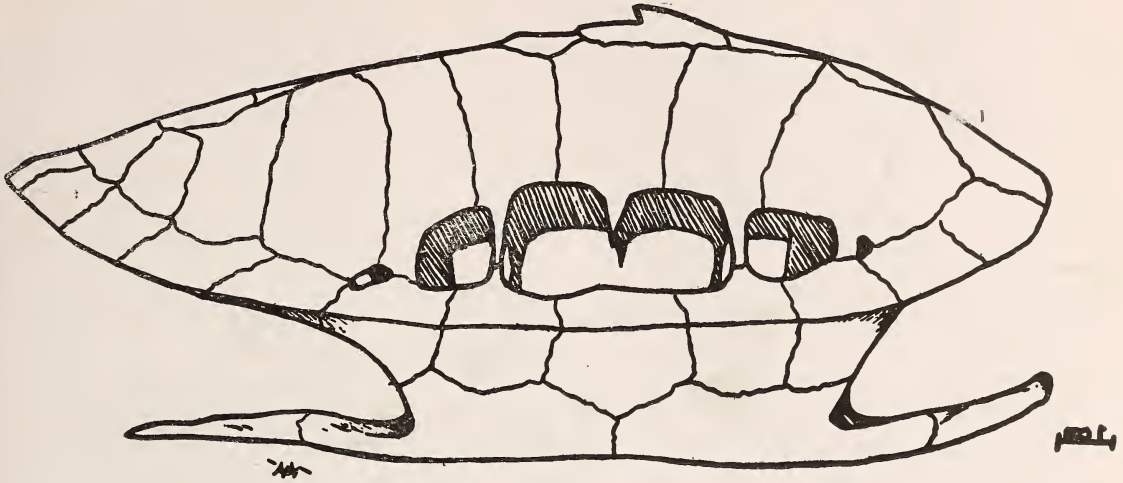


Fig. 6. Shell of a *Kachuga drongoka* male with scutes removed to show large costo-periferal fontanelles.

contained 26 eggs with a RCM of 0.128. The ELI, EWI and EMI were 11.3, 7.9, and 0.498 respectively. Rao and Singh (1985) provided data for two others. One (415 cm and 7.86 kg) with 18 eggs had an RCM of 0.097 and ELI, EWI, and EMI of 14.4, 8.1, and 0.59. The other 40.5 cm CL (no weight given) contained 21 eggs having an ELI of 15 and an EWI of 9.5.

Three eggs incubated in a plastic refrigerator box on moist cotton at ambient temperatures ranging from 28 to 35 degrees hatched in 53 to 55 days. The earliest date of nest emergence observed on the Chambal River was 29 April (Rao and Singh 1985).

**Distribution:** The three-striped roofed terrapin occurs in the Ganges and Brahmaputra drainages of Nepal and India. Only a shell has been found in Bangladesh (Khan 1982) but considering the known distribution, its occurrence in this country is expected. Smith (1931) reported that the species occurred only as far westward as Allahabad on the Ganges

but recent records indicate that it is distributed throughout most of this river's drainage (Fig. 7).

Specimens were collected from the following localities during the survey:

- FMNH 224108 — Hindon River, Mohen Nagar, Ghaziabad, Meerut District, U.P.
  - BNHS 1343 — Yamuna River, nr. Etawah, Etawah District, U.P.
  - FMNH 224154 — Chambal River, Barendra, Morena District, M.P.
  - BNHS 1320 — Narayani River, Parsauni Farm, c. 40 km NW Bettiah, Bettiah (W. Champaran) District, Bihar.
  - EOM 2751 — Ganges River, Kahalgaon, c. 50 km W. Sahibganj, Bhagalpur District, Bihar.
  - EOM 2730 — Ganges River, Rajmahal, Dumka (Santhal Parghana) District, Bihar.
  - FMNH 224136 — Market at Belecoba, Jalpaiguri District, West Bengal. (Said to be from Bihar).
- In addition, I have examined preserved specimens from the following localities and judge them valid.
- ZSI 194+197 — Yamuna River, Agra, Agra District, U.P.
  - Yadava (1980) — Saryu River, Ayodhya, Faizabad District, U.P.



Fig. 7. Distribution map of *Kachuga dhongoka* in India based on surveys of Indian rivers conducted from 1981 to 1983 and including museum records verified by the author.

BMNH 1878.8.18.12 — Ganges River, nr. Varanasi, Varanasi District, U.P.

ZSI 18319+20 — Brahmaputra River, Sonarpur, Kamrup District, Assam.

***Kachuga kachuga* (Gray 1831)**

RED-CROWNED ROOFED TERRAPIN — Plate I, C-F

*Identification:* A large riverine *Kachuga* (to 56 cm CL) having two denticulated ridges on the palate, an unpatterned carapace, a second vertebral scute with a straight posterior margin and a pair of oval yellow, red or orange patches on throat.

*Description:* Sexual dichromatism pronounced. Males (FMNH 224128 and BNHS 1341): carapace — unpatterned, drab to brownish olive, a wash of red may be present along midline anteriorly; plastron — unpatterned, cream to light yellow; head and neck brightly patterned; ground color of head blueblack a broad geranium red patch extending from top of snout to occiput; neck creamy white dorsally with six bright parallel red stripes, four of which converge at posterior of head merging into red patch (most descriptions of this species in the literature state there are seven red stripes on the neck; this may be an error perpetuated from the early descriptions, at least this was not true of these males); two sulfur yellow stripes mark the side of the head — a post ocular running from the eye across the top of the tympanum and another beginning at the snout, crossing over the upper mandible and the lower edge of the tympanum onto the neck; iris and sclera of eye orange to orange yellow; lower mandible with a creamy white stripe along its lower border; throat creamy-white with an orange oval spot on each side; limbs brownish olive anteriorly with a wash of yellow. (Anderson 1878 reported red on the limbs but none was evident here.)

The bright male coloration appears some-

what seasonal. FMNH 224128 appeared as above when captured in January but after two months in captivity, the red stripes had darkened to a deep red (almost maroon), the whitish areas between the stripes had become gray and the orange to orange-yellow eyes had become light yellow.

Females (FMNH 224152): dorsum unpatterned; coloration dark brown to black including carapace, head, eyes, neck, and anterior face of limbs; silvery to pale yellow mandibles in conspicuous contrast to the otherwise dark turtle; plastron pale yellow but under side of marginals marked with diffuse melanin. (Note: Another female obtained from the Calcutta markets differed from the above by having a poorly defined, light postocular stripe and considerable dark pigment on the plastral scutes.)

Head medium-sized with a slightly, upturned, somewhat projecting snout; skin of head smooth anteriorly dividing into irregularly shaped scales postero-laterally; jaws strongly serrated; upper, weakly bicuspid with shallow notch; lower with a single central tooth flanked by notches; palate broadly expanded, its triturating surface bearing two denticulated ridges (as in *Batagur*), the anterior being most prominent; lower jaw with pronounced coronoid process and triturating surface bearing single denticulated ridge (*Batagur* differs in having a low coronoid process and a second ridge at posterior edge of triturating surface).

Shell oval, widest across Vertebral 4 between the seventh marginals; a median keel with prominent knob on Vertebral 2 and lesser knobs on Vertebrae 3-5 becoming obscure in older individuals; seam contact formula: 1M 4> 6M 8M 11<; Vertebrae 2 and 4 usually longer than wide while Vertebrae 1, 3, and 5 are wider or as wide as long; plastron narrow, shallowly notched posteriorly and truncated anteriorly; plastral formula: Ab>

F > H > P > A > G; bridge width extensive exceeding length of either plastral lobe.

Anderson (1876) reported that the cloacal bursae are present but that their walls are smooth not lined with villi as in the *Pangshura*.

*Size and Sexual Dimorphism:* Measurements of four males and three females examined on the survey are as follows:

FMNH 224127 M(shell) — 25.2 CL 19.8 CW  
23.7 PL

Living M — 26.5 CL 21.2 CW 24.2 PL 10.9  
H

BNHS 1341 M — 27.9 CL 20.6 CW 24.5 PL  
11.3 H 2.5 kg

FMNH 224128 M — 29.0 CL 22.1 CW 25.1  
PL 10.9 H 3.1 kg

FMNH 224152 F — 47.8 CL 36.9 CW 45.6  
PL 20.4 H 15.7 kg

Living F — 50.4 CL 38.3 CW 48.0 PL 20.2  
H 18.6 kg

EOM 2841 F(shell) -- 52.0 CL 38.2 CW

Males differ from females by having brighter coloration, smaller size, four prominent costo-peripheral fontanelles in the shell and a relatively long tail in which the vent opens beyond the edge of the carapace.

*Hatchlings and Immatures:* A recently hatched individual (Pl. I-E) from a clutch obtained on the Chambal River in U.P. measured: 6.0 CL 5.0 CW 5.6 PL 2.9 H 36 g Wgt. The shell is strongly serrated posteriorly (more than in *K. dhongoka*). Sharp spines are present on the free edges of Marginals 5-7; spines on Marginals 8-12 are blunt but a deep notch just anterior to each gives the posterior of the carapace a ragged appearance. The mid-dorsal keel is modified into blunt spines on Vertebrae 2 and 3 and a small sharp spine on 4. Lateral keels are indicated by a weak ridge over the pleurals. On the plastron two parallel ridges running along either side from humeral

to anal scute are decked with a small sharp spine at the posterior of each scute.

The shell is light grayish-olive above with a pale yellow band along the periphery of Marginals 4-12. The plastron is pale yellow and unpatterned. The head is olive brown with a broad, light cinnamon stripe extending posteriorly from the eye over the tympanum and onto the neck; immediately beneath a wide plumbeous to dark neutral-gray stripe runs from beneath the eye and the angle of the mandibles over the lower part of the tympanum to the neck. Within this dark stripe a narrow light neutral-gray runs from beneath the eye to the tympanum. Six faint stripes of light cinnamon outlined in black are discernible on the neck. The throat is pearl gray decked with dark oval patches on either side instead of bright orange as in adults.

An immature specimen (20.5 CL 16.0 CW 18.9 PL 8.8 H and 1.24 kg) from Bateshwar, U.P. (Pl. I-F) is briefly described herein to provide additional information on ontogenetic change in coloration. The carapace is olive gray to drab with central keel paler in color. The cream colored plastron is unpatterned. The head is olive-gray with a broad creamy band running along dorso-lateral portion from top half of eye over tympanum to neck. Below a medium neutral-gray band runs from lower portion of eye posteriorly over tympanum onto the neck. The neck, also medium neutral-gray, is decked by six somewhat darker gray stripes. The iris is amber. The mandibles are light orange-yellow near the tomium and olive-gray elsewhere. The limbs are olive-gray anteriorly and creamy white posteriorly.

*Natural History:* Little has been published concerning the habits of this species and what information is available must be viewed with caution as the turtle may be easily confused with *Batagur*.